How will the CO2 remain stored?

CO_2 storage relies on features and characteristics of naturally occurring geological formations to keep the CO_2 safely and permanently trapped. Firstly, the CO_2 is injected at great depths, over 800m below the surface – almost five times deeper than the Ponte Tower in Johannesburg.. This ensures that the CO_2 stays in a very dense state, similar to a liquid, because of the increased pressure at this depth and ensures the CO_2 is stored efficiently. Once the CO_2 is in the rock formation, there are a series of naturally occurring trapping mechanisms to ensure that it stays there.

The trapping mechanisms are as follows:

- Structural/stratigraphic trapping – this is the most important trapping mechanism in the early stages of CO_2 storage. When CO_2 is injected into a geological formation it is less dense (lighter) than the very salty brine that naturally fills the formation. Because it is lighter than the surrounding fluid it rises in the formation until it hits the cap-rock – a thick impermeable layer of rock that overlies the storage formation. This cap-rock prevents the CO_2 from rising any further, thus trapping the CO_2 within the storage formation.
- Residual trapping – when CO_2 is injected into the storage formation it is not injected into a large cavern but rather into the microscopic pores that exist within the rock – similar to the holes in a sponge only on a much smaller scale. As the CO_2 moves through these pores small amounts of CO_2 will be trapped in the pores preventing it from moving any further.
- Solubility trapping – before CO_2 injection starts, the geological storage formation is filled with very salty brine water – many times saltier than sea water. When the CO_2 is injected it comes into close contact with the brine. Overtime the CO_2 will start dissolving into the brine. Once the CO_2 is dissolved into the brine it will no longer rise in the formation and will remain trapped.
- Mineral trapping – over very long time periods, the CO_2 can react with the rock in the storage formation and form a solid mineral. This is a very, very slow process but once it has occurred the CO_2 can never leave the storage formation.

The above is a rough indication of the order in which the trapping mechanisms will occur – the first mechanisms happening very early in the project life cycle with the last mechanisms happening over time. When exploring for a site to store CO_2 many years of work takes place to make sure the trapping mechanisms above are present at the site and will safely and permanently store the CO_2.

Once a site has been selected and the trapping mechanisms are confirmed, additional confidence will be provided by implementing an extensive monitoring programme pre-injection, during and post injection which can analyse the following:

- Storage formation itself;

- The cap-rock;
- The 800m or more of earth between the $CO_{2;}$ and
- The surface as well as the air above the site.

Given most of this monitoring is outside the storage formation, it is unlikely that it will ever detect the presence of CO_2 however it is kept in place just to make sure.